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HIGGINSITE, A NEW MINERAL OF THE OLIVENITE GROUP

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The new mineral described in this paper was found by J. B. Tenney at the Higgins Mine, Bisbee, Arizona and was sent to the Harvard Mineralogical Museum for determination in 1917. Mr. Tenney, then Chief Geologist of the Phelps-Dodge Corporation, described the occurrence of the mineral in the following words:—"The mineral occurs always with manganese ore on or near the surface. The manganese minerals are psilomelane, braunite and pyrolusite. Occasionally barite occurs with it also, and the manganese passes on the edge of the deposits into limonite (or gòethite) intergrown with cherty quartz, or into crystalline limestone. The form and nature of the occurrence suggest replacement of pure limestone by manganese, iron and silica, carried in strong sulfate solutions. The green mineral appears to be of the same age, as far as can be told."

The authors take pleasure in following the suggestion of Mr. Tenney that this mineral bear the name *higginsite,* after the Higgins Mine, where it was found.

The specimens received show crystals and granular masses of higginsite interspersed thru black manganese ores with an occasional plate of white barite. The color of the crystals is a vivid malachite green; of the granular material, yellow green. The powder is distinctly yellowish green, with a brownish cast. In the coarsest material grains as much as 2 cm. in diameter were seen, but the largest crystal measured was about 5 mm. in length.

Crystallography—Higginsite is orthorhombic, with the elements:

$$p_0 = 1.272 \qquad q_0 = .7940.$$

Details are given on a later page. Its close relationship in

form to olivenite and descloizite is shown by comparison of their axial ratios:

	a : b : c
Higginsite	.6242 : 1 : .7940
Descloizite	.6368 : 1 : .8045
Olivenite ($^2/_3$a)	.6264 : 1 : .6726

Figures 1 and 2 show the prevailing habits of the crystals. The prismatic habit is most frequent in those at hand; but the domatic development, either as shown or with nearly equal extension parallel to the two horizontal axes, gives some crystals an octahedroid appearance. The lack of any pronounced cleavage makes the orientation of the crystals difficult. The faces, especially of the pyramid forms, are of good luster and gave on the whole very satisfactory reflections on the goniometer.

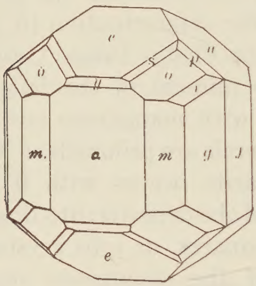

Fig. 1

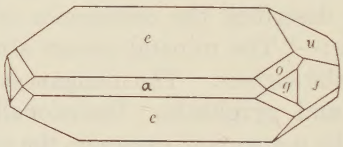

Fig. 2

Physical Characters.—Hardness about 4.5; specific gravity 4.33. The optical properties were studied by Mr. T. Matsumoto and partly determined as follows, the small size and opacity of the crystals rendering complete results unattainable:

Refractive index $\beta > \alpha > 1.745$; birefringence approx. 0.030.

Optical orientation: X || a, probably Bx_a; Y || b; Z || c; Axial plane therefore parallel to (010).

Opt. character:—(?); axial angle large; dispersion $v > \rho$ (if —).

Absorption Y > X > Z; pleochroism marked: X green; Y yellow green; Z blue green.

Chemical Composition.—The analyses (by E. V. S.) were made on carefully hand-picked grains, freed as far as possible from manganiferous gangue. Some of the latter appeared to be present as dust even in the clearest crystals and could not be wholly removed. The final analysis was made upon about 1 gram of material, the check determination of copper and calcium on a half gram of the same powder.

TABLE 1
ANALYSES OF HIGGINSITE, BY E. V. SHANNON

	1	2	Av.	Ratios		
CuO	28.51	28.82	28.67	0.3603	1.93	2
CaO	20.92	20.74	20.83	0.3712	1.99	2
V_2O_5	1.97		1.97	0.1901	1.02	1
As_2O_5	41.23		41.23			
H_2O − 105° C	0.08		0.08			
H_2O + 105° C	3.41		3.41	0.1892	1.02	1
Fe_2O_3	0.48		0.48			
MnO	2.84		2.84			
Gangue (Insoluble)	0.86		0.86			
Total	100.30		100.37			

All the iron and manganese is regarded as extraneous and derived from the gangue material. Deducting these, with the insoluble material and hygroscopic water, the average analytical figures yield the ratios in the last column.

These ratios then yield quite closely the formula:

$$2\ CuO.\ 2\ CaO.\ As_2O_5.\ H_2O \text{ or } Cu\ Ca\ (OH)\ (AsO_4)$$

Arsenic is replaced to a small extent by vanadium. This may be compared with the formulas of olivenite and descloizite: 4 CuO. As_2O_5. H_2O, and 2PbO. 2 ZnO. V_2O_5. H_2O, which are typical of the olivenite group.

Recalculating the essential constitutents of the mineral to 100% and comparing with these figures the composition required by the formula derived above we obtain the following figures.

	Original	Recalculated to 100 %	Theory for Cu Ca $OHAsO_4$
CuO	28.67	29.83	30.65
CaO	20.83	21.67	21.60
V_2O_5	1.97	2.05	44.28
As_2O_5	41.23	42.90	
H_2O	3.41	3.55	3.47

These figures show a very satisfactory agreement.

Pyrognostic Characters.—Higginsite fuses at about 3, coloring the flame at first pale blue (As) and then blue green (Cu). On charcoal alone it fuses to a black slag without flame coloration or coating; with soda and borax it is reduced to metallic copper, yielding a faint arsenic reaction. In the closed tube it decrepitates slightly, turns black, and at a red heat gives off a little neutral water. Gives no arsenic sublimate when heated with charcoal in the closed tube. It is readily soluble in nitric and hydrochloric acids; partially soluble in sulfuric acid; insoluble in ammonia.

THE GOLDSCHMIDT TWO-CIRCLE METHOD. CALCULATIONS IN THE ORTHORHOMBIC SYSTEM

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The following relations may be derived from the diagram, figure 32, in which pq is the face-pole of a pyramid for which the angles φ and ρ are known:

$$x = \sin\varphi \tan\rho = pp_0;\ y = \cos\varphi \tan\rho = qq_0$$

From these, p and q being known, p_0 and q_0 can be calculated.

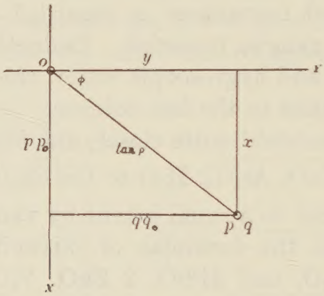

FIG. 32

Each face gives values for x and y and the averages for n faces have the form:

$$p_0 = \frac{1}{n}\left(\frac{x_1}{p_1} + \frac{x_2}{p_2} + \ \ldots\ + \frac{x_n}{p_n}\right)$$

$$q_0 = \frac{1}{n}\left(\frac{y_1}{q_1} + \frac{y_2}{q_2} + \ \ldots\ + \frac{y_n}{q_n}\right)$$

For domes: If $y = 0$, $x = pp_0$; If $x = 0$, $y = qq_0$.
For prisms:

If the angle hk0 to 010 $= \varphi$, $\tan\varphi = \dfrac{pp_0}{qq_0}$.

RELATIONS OF ELEMENTS TO LINEAR AXES

$$p_0 = \frac{c}{a}.\quad q_0 = c.\quad a = \frac{q_0}{p_0}.\quad c = q_0$$

CALCULATION OF ANGLES FROM ELEMENTS

From the diagram and equations of the first paragraph we have for any face, pq:

$$\frac{x}{y} = \frac{pp_0}{qq_0} = \tan\varphi;\ \frac{x}{\sin\varphi} = \frac{y}{\cos\varphi} = \tan\rho;\ \sqrt{x^2 + y^2} = \tan\rho$$

For domes: If $x = 0$, $\tan \varphi = 0$, $\varphi = 0$; $\tan \rho = qq_0$.
If $y = 0$, $\tan \varphi = \infty$, $\varphi = 90°$; $\tan \rho = pp_0$.
For prisms:

$$\frac{p}{q} \infty, \tan \varphi = \frac{pp_0}{qq_0}; \tan \rho = \infty, \rho = 90°.$$

ILLUSTRATION OF THE ORTHORHOMBIC SYSTEM. MEASUREMENTS AND CALCULATIONS ON HIGGINSITE

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As an illustration of the application of the formulas given in the preceding article, the following discussion of a crystal of the new mineral higginsite, described above, may well serve. The measurements of one crystal are given in full in Table 1, the form of calculation being that used thruout in Goldschmidt's work. In this table, columns 1, 2, 5, and 6 contain the record of actual observation on the goniometer. The numbers of col. 1 are those used to mark the faces in the note-book sketch of the crystal; the letters of col. 2 stand for good, fair and poor, depending on the quality of the reflected signals; col. 5 contains the angles read on the vertical circle, V, col. 6 those on the horizontal circle, H, of the goniometer.

These angles were plotted in gnomonic projection yielding a diagram similar to figure 33. The next step was the choice of the unit form. Either of the pyramids, o and p, might have been taken for this and its coördinates would then have been the elements, p_0 and q_0. The choice fell upon o because this form is more prominently developed on the crystals; the zonal relations with other forms are at least as good; and its selection brings to expression the isomorphism of the new species with descloizite, as will be shown below.

The unit form chosen, the Goldschmidt symbols could be read at once from the projection; they are entered in col. 3. The letters of col. 4 follow the usage for the mineral descloizite.

Determination of the value v_0 was next in order. The projection showed that the face 1 will have $\varphi = 0$, and therefore v_0 would be close to 77°28′, the V reading of face 1. Each of the pairs of faces: 2 and 3; 4 and 5; 8 and 9; are symmetrically dis-

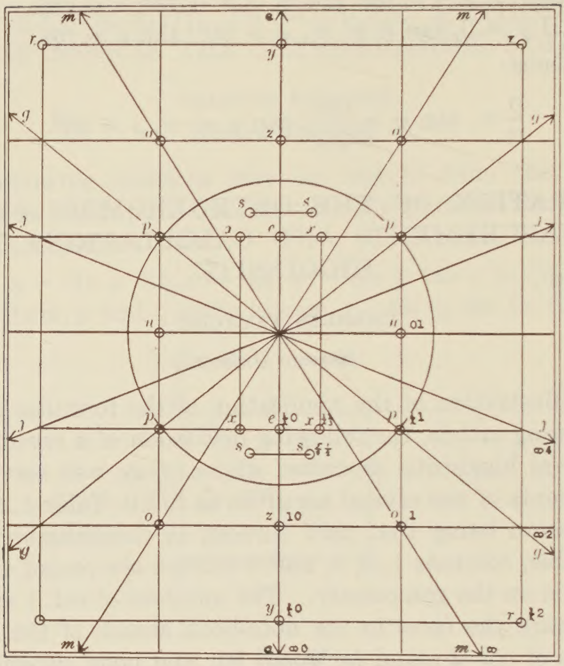

FIG. 33

posed to 1, and the half-sums of the V readings of each pair gave independent values for v_0. Faces 6 and 7 should be 90° from face 1 in φ, and the prism faces also yielded, either directly or by taking the half-sum of symmetrical readings, other values of v_0. The average of all is 77°29′ which, subtracted from each angle in col. 5, gives the values of φ entered in col. 7.

Col. 8 contains the values of ρ obtained from col. 6 by subtracting each from h_0 = 260°, a constant for the instrument.

The calculation of p_0 and q_0 followed. In col. 9 was written first, lg tan ρ for each face (except prisms); then lg sin φ and lg cos φ respectively above and below the first. Col. 10 contains the sums of these logarithms, above the upper two, below the lower two, the logarithms respectively of x and y. This addition proceeds most rapidly if done beginning at the left hand side of the numbers to be added, the sum being then written in col. 10 in order from left to right, a trick of addition (or subtraction)

TABLE 1, on following page and half of page 162, gives the measurements on the higginsite and the calculations therefrom.

1	2	3	4	5	6	7	8	9	10	11	12	13
No.	Qual.	Symbol	Letter	v	h	φ $v_0 = 77° 29'$	ρ $h_0 = 260°$	lg sin φ lg tan ρ lg cos φ	lg x lg y	$x = pp_0$ $y = qq_0$	$\frac{1}{2}p_0$	q_0
1	G	01	u	77°28′	221°46′	00°01′	38°14′	∞ 989645 0	 989645	 .7879		 .7879
2	G	$\frac{1}{2}$1	p	38 44	214 37	−38 45	45 23	979652 000581 989203	980233 989784	.6343 .7904	.6343	 .7904
3	P	$\frac{1}{2}$1	p	116 15	214 37	38 46	45 23	979668 000581 989193	980249 989774	.6346 .7902	.6346	 .7902
4	P	1	o	19 35	203 49	−57 54	56 11	992795 017401 972542	010196 989943	1.264 .7933	.6320	 .7933
5	F	1	o	135 15	204 06	57 46	55 54	992731 016938 972703	009669 989641	1.249 .7878	.6245	 .7878
6	P	$\frac{1}{2}$0	e	348 25	227 37	−89 04	32 23	999994 980223 ∞	980217 —	.6341	.6341	
7	G	$\frac{1}{2}$0	e	167 00	227 33	89 31	32 27	999998 980335 ∞	980333 —	.6358	.6358	
8	F	$\frac{3}{2}$2	r	127 19	191 56	49 50	68 04	988319 039505 980957	027824 020642	1.898 1.602	.6326	 .8010
9	F	$\frac{3}{2}$2	r	27 13	191 58	−50 16	68 02	988594 039432 980565	028026 019997	1.907 1.585	.6356	 .7925
10	P	$\frac{5}{8}\frac{1}{4}$	s	153 55	222 06	76 26	37 54	998771 989125 937028	987896 926153	.7568 .1826	.6056	 .7304

Average $\frac{1}{2}p_0$ .6327 q_0 .7919

No.	Qual.	Symbol	Letter	v	h	φ	ρ	$\lg\tan\varphi = \lg\frac{pp_0}{qq_0}$	$\frac{pp_0}{qq_0}$	$\frac{p_0}{q_0}$
11	P	$\infty 0$	a	347°13′	170°00′	−89°16′	90°00′	∞		
12	F	∞	m	19 22	"	−58 07	"	020618	1.608	1.608
13	G	$\infty 2$	g	38 58	"	−38 31	"	990061	.7954	1.5908
14	P	$\infty 4$	j	55 54	"	−21 35	"	959725	.3956	1.5814
15	P	$\infty 4$	j	99 35	"	22 06	"	960859	.4061	1.6244
16	F	$\infty 2$	g	115 56	"	38 27	"	989983	.7940	1.588
17	F	∞	m	135 40	"	58 11	"	020731	1.612	1.612
18	P	$\infty 0$	a	167 27	"	89 58	"	∞	—	—

Average $\frac{p_0}{q_0} = 1.599$

soon learned with a little practice. All the logarithms of col. 10 having been obtained, the numbers corresponding to each were found from the table, and entered in col. 11 opposite each. The upper number of each horizontal line in col. 11 is a value of $x = pp_0$; the lower a value of $y = qq_0$. p and q having been determined graphically (s y m b o l, col. 3) the numbers of col. 11 yielded a series of values for p_0 ($\frac{1}{2}p_0$ in col. 12) and q_0 (col. 13) the average of which gave the elements of the crystal. The prisms yielded the ratio of p_0 to q_0 by a simple calculation as shown. The result of the calculation of this crystal were as follows:

$p_0 = 1.2654; q_0 = 0.7919;$

$\frac{p_0}{q_0} = 1.597$ (from prisms $\frac{p_0}{q_0} = 1.599$).

A similar calculation may be made for each crystal measured and the results averaged. Possibly a simpler method is to average the angles for each form, make one calculation from these angles, and, weighting the resulting element values according to the number and quality of the readings for each form, find a final average. Table 2 shows the observed forms and angles (averaged) measured on eight crystals of higginsite together with the range of variation of each angle. The values of the elements p_0 and q_0 there given are the basis for the calculation of the φ and ρ angles of the same table. Table 3 shows the meth-

od of this calculation. The columns are numbered and the nature of the content of each is indicated by the heading. The lowest group of figures in each heading indicates the operation by which the values of the column were obtained. For example in col. 3, (1 + lg. p) means that lg. p is added to each logarithm of col. 1; in col. 5, (3–4) means that the logarithm of col. 4 is to be subtracted from that of col. 3; in col. 9 (3–6 = 4–7) means that the result of subtracting each logarithm of col. 6 from that of col. 3 should equal the result of subtracting each logarithm of col. 7 from that of col. 4. Incidentally this identity is a check on the calculation of each set of angles. After the values of lg. tan φ are obtained in col. 5, the angle is found from the table, entered in col. 8 and at the same time the lg. sin and lg. cos entered in cols. 6 and 7. ρ is obtained from lg. tan ρ of col. 9.

Each operation is thus a horizontal addition or subtraction or the result of adding a common value to a vertical series of numbers. All operations are supposed to be done mentally or with the aid of a slip of paper on which a commonly used value may be written. With comparatively little practice they become very easy and rapid.

In the Introduction to Goldschmidt's *Winkeltabellen* will be found forms similar to this for the calculation of crystals of each system. It was in this way that the enormous labor of calculating all the angles contained in that work was accomplished.

TABLE 2

Higginsite. Angle Table of Calculated and Observed Values.

$p_0 = 1.272 \quad q_0 = .7940$

	Symbol		Calculated		Measured		No. of Faces	Limits	
	Mill.	Gdt.	φ	ρ	φ	ρ		φ	ρ
a	100	$\infty 0$	90°00′	90°00′	90°00′	90°00′	12		
B	210	2∞	72 40	"	72 40	"	2	72°08′–73°12′	
C	320	$\frac{3}{2}\infty$	67 24	"	68 03	"	4	67 20–68 48	
m	110	∞	58 02	"	58 03	"	7	57 48–58 15	
g	120	$\infty 2$	38 42	"	38 32	"	5	38 17–38 47	
j	140	$\infty 4$	21 50	"	21 52	"	9	20 59–22 33	
u	011	01	00 00	38 27	00 00	38 24	6		38°06′–38°47′
e	102	$\frac{1}{2}0$	90 00	32 27	90 00	32 28	6		32 18–32 50
z	101	10	"	50 51	"	52 11	1		
y	302	$\frac{3}{2}0$	"	62 20	"	62 20	3		62 04–62 39
o	111	1	58 02	56 18	58 02	56 09	7	57 39–58 18	55 54–56 30
p	122	$\frac{1}{2}1$	38 42	45 30	38 38	45 38	7	38 00–39 40	44 50–46 00
r	342	$\frac{3}{2}2$	50 14	68 04	50 15	68 06	7	50 00–50 39	67 19–68 35
s	528	$\frac{5}{8}\frac{1}{4}$	75 59	39 20	76 41	39 25	2		
A	746	$\frac{7}{6}\frac{2}{3}$	70 22	57 36	70 00	59 34	2		
x	326	$\frac{1}{2}\frac{1}{3}$	67 24	34 34	67 53	34 33	2		

TABLE 3

Table to show Method of Calculation of Angles
(See *Winkeltabellen*, pp. 18, 19 & 19a).

Mineral Higginsite Elements $p_0 = 1.272$ $\lg p_0 = 010449$ $q_0 = .7940$ $\lg q_0 = 989982$	Let. Symb. pq	1 lg p	2 lg q	3 $\lg x = \lg pp_0$ $1 + \lg p$	4 $\lg y = \lg qq_0$ $2 + \lg q$
	o 1	0	0	010449	989982
	$p\frac{1}{2}1$	969897	0	980346	989982
	$r\frac{3}{2}2$	017609	030103	028058	020085

5 $\lg \frac{pp_0}{qq_0} = \lg \tan \varphi$ $3 - 4$	6 $\lg \sin \varphi$ from 8	7 $\lg \cos \varphi$ from 8	8 φ from 5	9 $\lg \frac{pp_0}{\sin \varphi} = \lg \frac{qq_0}{\cos \varphi}$ $= \lg \tan \rho$ $3 - 6 = 4 - 7$	10 ρ from 9
020467	992858	972381	58°02′	017591 017601	56°18′
990364	979605	989233	38 42	000741 000749	45 30
007973	988573	980595	50 14	039485 039490	68 04

LISTS OF THE ORTHORHOMBIC MINERALS INCLUDED IN GOLDSCHMIDT'S WINKELTABELLEN. Edgar T. Wherry. *Washington, D. C.*—As the prism zone is on the whole most characteristic of orthorhombic crystals, it has seemed desirable to arrange the minerals of this system in the order of increasing values of axis *a*.

Orthorhombic Minerals

	a	*c*	Page
Uranophanite	0.31	1.01	355
Polycrasite (Polykras)	0.35	0.31	271
Euxenite	0.36	0.30	137
Molybdite	0.39	0.47	243
Columbite	0.40	0.36	101
Oanneroedite (Anerödit)	0.40	0.36	45
Flinkite	0.41	0.74	147
Monticellite	0.43	0.58	253
Fayalite	0.46	0.58	252
Tephroite	0.46	0.59	254
Hjelmite	0.46	1.03	177
Olivine	0.47	0.59	251
Ardennite	0.47	0.31	53
Chrysoberyl	0.47	0.58	97
Aeschynite	0.48	0.67	31
Diaphorite	0.49	0.73	115
Pyrostilpnite (Feuerblende)	0.50	0.70	145
Wavellite [old data]	0.50	0.38	362
Topaz	0.53	0.95	346
Pucherite	0.53	1.17	274
Phosphosiderite	0.53	0.88	266
Jordanite	0.54	1.02	191
Yttrotantalite	0.54	1.13	371
Rammelsbergite	0.54	——	291
Samarskite	0.55	0.52	309
Struvite	0.55	0.62	332
Mascagnite	0.56	0.73	232
Bertrandite	0.57	0.60	64
Hopeite	0.57	0.47	180
Beryllonite	0.57	0.55	66
Mica (Glimmer)	0.58	3.29	161
Dyscrasite (Antimonsilber)	0.58	0.67	49
Argentopyrite (Silberkies)	0.58	0.55	318
Stromeyerite	0.58	0.97	330
Chalcocite (Kupferglanz)	0.58	0.97	205
Sternbergite	0.58	0.84	329

Caracolite 0.58	0.42	88
Iolite (Cordierit) ...0.59	0.56	103
Niter (Kalisalpeter).0.59	0.70	194
Bromlite (Alstonit)..0.59	0.74	34
Cotunnite.........0.59	1.19	105
Fischerite..........0.59	——	147
Carnallite..........0.60	1.39	88
Frieseite...........0.60	0.74	153
Thenardite.........0.60	1.25	341
Orpiment (Auripigment)...........0.60	0.67	57
Witherite..........0.60	0.73	365
Euchroite..........0.61	1.04	133
Strontianite........0.61	1.04	331
Cerussite 0.61	0.72	89
Schrockingerite.....0.61	——	313
Zoisite 0.62	0.34	379
Aragonite..........0.62	0.72	51
Stephanite (Melanglanz)...........0.63	0.69	233
Kentrolite 0.63	0.90	197
Descloizite.........0.64	0.80	113
Polyhalite 0.64	——	270
Variscite...........0.65	——	358
Nesquehonite 0.65	0.46	248
Atacamite(Atakamit)0.66	0.75	56
Lawsonite 0.67	0.74	216
Ilvaite (Lievrit) 0.67	0.44	220
Loellingite (Löllingit) 0.67	1.23	223
Lithargite (Bleioxyd)0.67	0.98	72
Sundtite...........0.68	0.45	333
Arsenopyrite (Arsenkies) 0.68	1.19	55
Glaucodotite (Glaukodot)...........0.69	1.19	160
Acanthite (Akanthit)0.69	0.99	32
Erythrosiderite.....0.69	0.72	132
Staurolite..........0.69	0.98	327
Epigenite 0.69	——	131
Tungstite 0.70	1.61	352
Hydrocyanite.......0.71	1.26	186
Polymignite 0.71	0.51	271
Harstigite 0.71	1.01	171
Laurionit 0.73	0.83	214
Alloclasite (Alloklas).0.74	0.55	34
Klaprothite 0.74	——	199
Marcasite (Markasit).............0.76	1.21	232
Euchlorite 0.76	1.88	133
Fluellite...........0.77	1.87	148
Eosphorite.........0.78	0.52	128
Brochantite 0.78	0.49	393
Childrenite 0.78	0.53	93
Celestite (Cölestin)..0.78	1.28	98
Calamine, Hemimorphite (Kieselzinkerz).............0.78	0.48	197
Lecontite 0.78	1.53	218
Valentinite 0.79	1.41	357
Anglesite 0.79	1.29	42
Langite............0.79	0.42	212
Daviesite 0.79	0.48	112
Hambergite 0.80	0.73	169
Chalcostibite (Wolfsbergit) 0.80	0.63	367
Mendipite 0.80	——	237
Sulfur (Schwefel) ...0.81	1.91	313
Barite (Baryt) 0.82	1.31	60
Bismite [trigonal?]..0.82	1.60	70
Jamesonite 0.82	——	187
Thermonatrite 0.83	0.81	341
Pinakiolite 0.83	0.59	267
Haidingerite 0.84	0.99	168
Prehnite...........0.84	1.12	272
Brookite...........0.84	0.94	80
Manganite.........0.84	0.54	230
Kornerupite........0.85	——	200
Serpierite 0.86	1.36	316
Prismatite 0.86	0.83	273
Mazapilite.........0.86	0.99	233
Strengite..........0.87	0.98	330
Scorodite (Skorodit).0.87	0.96	321
Triphylite 0.87	1.05	350
Enargite...........0.87	0.82	127
Dufrenite (Kraurit).0.87	0.43	201
Pseudobrookite 0.87	0.89	274
Nadorite 0.89	1.39	245
Zinkosite 0.89	1.41	374
Anhydrite..........0.89	1.01	44
Spodiosite 0.89	1.58	325
Zinckenite 0.90	1.14	372
Ochrolite 0.91	2.01	250
Hemafibrite (Hämafibrit) 0.91	1.74	68
Reddingite 0.91	1.05	293
Tellurite...........0.92	0.93	339
Caledonite 0.92	1.41	87
Danburite 0.92	0.88	108
Goethite (Göthit)...0.92	0.61	162
Cosalite 0.92	1.46	104
Synadelphite 0.92	1.72	337
Gerhardtite 0.92	1.16	156
Stilbite (Desmin) ...0.93	0.76	113
Diasporite 0.94	0.60	116
Bournonite.........0.94	0.90	76
Dufrenoysite 0.94	1.53	120
Krennerite.........0.94	0.51	202
Stylotypite.........0.94	——	331
Meneghinite 0.95	0.69	238
Olivenite 0.95	0.68	251
Lanthanite.........0.95	0.90	213
Uranothallite.......0.95	0.78	355
Newberyite 0.95	0.94	249
Sartorite (Skleroklas) 0.96	0.77	320
Libethenite........0.96	0.70	220
Emplectite (Emplektit) 0.96	0.77	126
Bismuthinite (Wismuthglanz) 0.97	0.99	364
Adamite 0.97	0.72	30

Patrinite	0.97	——	258
Sillimanite	0.97	——	319
Andorite	0.98	0.87	41
Goslarite (Zinkvitriol)	0.98	0.56	375
Natrolite	0.98	0.35	246
Morenosite (Nickelvitriol)	0.98	0.57	249
Nagyagite	0.98	1.78	245
Gismondite	0.99	0.94	157
Andalusite	0.99	0.70	40
Guarinite	0.99	0.74	166
Epsomite	0.99	0.57	132
Astrophyllite	0.99	4.70	55
Stibnite (Antimonglanz)	0.99	1.02	47
Thomsonite	0.99	1.01	342
Leucophanite (Leukophan)	0.99	0.67	219
Ludwigite	0.99	——	224
Cerite	1.0–	0.81	89
Uranospinite	1.0–	1.46	355
Geocronite (Geokronite)	1.01	0.58	156
Enstatite [group]	1.03	0.59	281
Hydromagnesite	1.04	0.47	186
Kermesite (Antimonblende)	1.32	0.85	46
Polybasite	1.73	1.58	270
Epididymite	1.74	1.85	128
Humite	2.20	1.08	181

Representatives of Classes with Diminished Symmetry

Class Hemimorphic

Struvite	0.55	0.62
Bertrandite	0.57	0.60
Calamine, hemimorphite	0.78	0.48
Prehnite	0.84	1.12

Class Sphenoidal

Epsomite	0.99	0.57
Leucophanite	0.99	0.67
Edingtonite	1.0–	0.95

Peri-orthorhombic

Mica group	Monoclinic
Polybasite	Monoclinic

NOTES AND NEWS

A CALCIUM PHOSPHATE WITH RATIOS BETWEEN THOSE OF TRIPLITE AND SARCOPSIDE. Edw. F. Holden. *Hillsboro, N. H.*—In the writer's note on sarcopside in the May number of this magazine (pages 99–102), the formula-types of the various fluo-phosphates and related minerals were compared, in table 3; it was also noted in discussing that table that a ferrous fluophosphate from Stoneham, Maine, has been found to show a composition lying approximately midway between the sarcopside and apatite ratios, $R:(F, OH):(PO_4) = 12:3:7$. The purpose of the present note is to call attention to another apparently intermediate mineral, also from Stoneham, the analysis of which is given (as a peculiar "apatite") in *U. S. Geol. Survey Bull* **591**, p. 349. The ratio derivable from this analysis is $11:6:4$, which is $\frac{2}{3}$ of the way from sarcopside to triplite $(7:2:4+2\times(2:1:1)=11:6:4)$. The chief base in this mineral is calcium, so the member of the triplite group concerned is spodiosite; but the properties of the Stoneham mineral are so unlike those ascribed to spodiosite as to make its distinctness seem at least possible. Studies of the optical properties, with special reference to homogeneity, of minerals appearing to occupy intermediate positions in the series are necessary, however, before their status can be settled.

NOTE ON SULFUR AS A MINERAL OF THE MOON. Edgar T. Wherry, *Washington, D. C.*—While looking up information on the occurrence of the element sulfur, the writer came across a reference to its presence on the moon,[1] and as its identification there is probably not generally familiar to mineralogists, a note upon the matter has been prepared. On making a photograph of the moon by ultra-violet light, Professor R. W. Wood noticed the presence of a peculiar dark spot bordering the crater known as Aristarchus. A view of the same region taken thru a yellow screen showed no such spot, while one thru a violet screen showed it faintly. Trials of different terrestrial volcanic rocks with the same color screens showed that corresponding effects were obtained only in rocks containing a thin film of sulfur, no other known substance yielding exactly the same results. And, as the form and position of the Aristarchus spot suggests that it represents material thrown out from the crater by a volcanic blast, the conclusion is justified that it consists either of ash containing sulfur, or of a deposit of this element formed by condensation of ejected vapor. Here is a practically untouched field for research—developing of methods for identifying moon minerals—or should we say moonerals?

TWO AMERICAN OCCURRENCES OF EPIDESMINE. Samuel G. Gordon. *Academy of Natural Sciences of Philadelphia*—Epidesmine, the orthorhombic form of $(Ca, Na_2)Al_2Si_6O_{16}.6H_2O$ (the monoclinic form of which is represented by the common zeolite stilbite), was described by Rosicky and Thugutt[2] in 1913 from Schwarzenberg, where it occurred as a crust on calcite associated with orthoclase and fluorite. As no other localities have yet been reported,[3] two American occurrences are worthy of note.

The mineral was collected by Mr. Frederick Oldach of the Reading High School, at a trap quarry one-half mile west of Robeson, or Gickerville, on the Schuylkill River, 7 miles south of Reading, Berks County. It occurs as small colorless or yellow prismatic crystals, a combination of the three pinacoids $a(100)$, $b(010)$, and $c(001)$; $a(100)$ is characteristically pearly, and sometimes slightly iridescent. The epidesmine is intimately associated with natrolite; other minerals noted in the quarry are stilbite (very abundant), prehnite, laumontite, chabazite, apophyllite, calcite, chrysocolla and epidote.

Col. Washington A. Roebling had previously identified the mineral at Moore Station, Mercer County, N. J. Optical examination of a specimen kindly presented by him to the writer showed it to be identical with the mineral from Schwarzenberg and Robeson.

The epidesmine from the three localities showed the following optical characters: optically $-$; $\alpha = 1.485, \beta = 1.495, \gamma = 1.500$, all $\pm$ .005; $\gamma - \alpha = 0.015$. Axial plane parallel to $a(100)$; $a = Y, b = Z, c = X$; $Bx_a \perp$ to c (001); 2E approximately 40°.

1 Wood, R. W. Selective absorption of light on the moon's surface and lunar petrography. *Astrophys. J.*, **36**, 75–84, 1912.

2 V. Rosicky and St. J. Thugutt: Epidesmin, ein neuer Zeolith, *Centr. Min. Geol.*, **1913**, 422–426; Ford: Third Appendix to Dana's System of Mineralogy, 27, 1915.

3 The "stilbite" figured by Heddle (Mineralogy of Scotland, II, plate LXXX, fig. 2, 1901), and by Böggild (Mineralogia Groenlandica, 562, fig. 108, 1905) is most probably epidesmine.

The John R. Stanton collection of mineral specimens has been sold to Mr. M. L. Morgenthau of New York City. The sale was made by G. S. Scott of New York who represented Mr. Stanton. The collection comprises 4500 specimens. For upwards of 30 years the collection was in the making, it having been originated by Mr. Stanton's brother and after his death Mr. John R. Stanton bought many very choice specimens and enlarged the collection considerably. Mr. Stanton's connection with the copper mines of Michigan secured for him what is probably the finest collection of native coppers in calcite known. Some of these calcites, clear as crystal and with native copper imbedded, make astonishingly beautiful specimens. Likewise Mr. Stanton's assortment of datolites from Michigan is unsurpassed, there being 100 or more beautiful polished specimens. His crystallized native silver and copper specimens from Lake Superior were many and choice In crystallized copper Mr. Stanton had several splendid specimens, the finest being one weighing 35 kg. and showing hundreds of perfect crystals. There were many most attractive specimens in the collection representing various minerals from every prominent locality. Mr. Morgenthau is to be complimented in having secured this splendid mineral collection. The collection for years had been on exhibition at Mr. Stanton's office, 15 William St., New York City.

The Extension Division of the University of California is offering a correspondence course in determinative mineralogy, given by Professor Arthur S. Eakle. While intended primarily for residents of California, it is available for everyone, no matter where they live, and is open for enrollment at any time. Believing that this course might be of interest to many of our readers, we have obtained further details about it, which will be found on page i of this issue. For additional information address Professor Allyn G. Smith, Chairman, Technical Department, University of California, Berkeley, Cal.

Villamaninite

W. R. Schoeller and A. R. Powell: Villamaninite, a new mineral. *Min. Mag.*, **19**, [88], 14–18, 1920.

Name: After the village Villamanin, Cármenes district, Prov. Leon, Spain.

Physical properties: Crystallization is cubic, with the octahedron and cubo-octahedron as the recognizable forms. H. = 4½. Color, iron black with a dull metallic luster. Streak, sooty black. No cleavage and uneven fracture. Sp. gr., 4.4–4.5.

Chemical properties: In closed tube gives sublimate of sulfur and selenium. Soluble in nitric acid with liberation of globule of sulfur. A sulfide of copper, nickel, cobalt, and iron, rich in selenium; probably a disulfide (Cu, Ni, Co, Fe) $(S, Se)_2$. Four analyses gave approx.: Cu 19, Ni 18, Co 7, Fe 4, S 50, Se 1½ per cent. Traces were also found of arsenic, bismuth, lead and zinc, while negative tests are reported for tellurium, thallium, indium and gallium.

Occurrence: Evenly disseminated thru a matrix of white crystalline dolomite, associated with chalcopyrite, iron pyrite and quartz. Occurs in groups of rough crystals and as small nodular masses with a radially fibrous structure.

W. F. Hunt.

[This material appears to be either a mixture, or a cupriferous polydymite. It is too poorly characterized to rank as a distinct and definite species.

W. F. F.]